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National Marine Fisheries Service

SOUTHWEST REGION

300 S. Ferry Street
Terminal Island, CA 90731

THE FATE OF RELEASED REHABILITATED PINNIPEDS BASED ON TAG-RESIGHT INFORMATION :
a preliminary assessment

Dana J. Seagars

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THE FATE OF RELEASED REHABILITATED PINNIPEDS BASED ON TAG - RESIGHT INFORMATION: a preliminary assessment

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SOUTHWEST REGION ADMINISTRATIVE REPORT SWR-88-1

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EXECUTIVE SUMMARY

Between May 1983 and December 31, 1986, 6 California rehabilitation centers treated and released 398 stranded pinnipeds (266 California sea lions, 97 northern elephant seals, 33 harbor seals, and 2 northern fur seals) to the wild with uniquely numbered orange plastic tags provided by the NMFS. Two tag types were used (Temple and Dalton Rotoriese); the rate of tag loss has not been determined for either, although an evaluation is in process for the type still in use.

Reported resights of these animals through calendar year 1986 were examined to assess the fate of releasees and to evaluate the scientific and management value of the rehabilitation center tagging program. Analysis showed that: 309 (77.6 per cent) animals were not resighted after release, 67 (16.8 per cent) were resighted alive one or more times and were not subsequently reported to restrand, 14 (3.5 per cent) were post-release mortalities, 7 (1.8 per cent) restranded, were retreated, re-released and not resighted, and 1 restranding was re-released and subsequently resighted twice. Most releases were concentrated in the Gulf of the Farallones south to Año Nuevo (53 per cent) or scattered throughout the Southern California Bight to the Mexican border (45 per cent). Of 89 animals resighted, 69 (78 per cent) were of northern area releases and 18 (20 per cent) were from the southern group (resight effort was high in the Gulf of the Farallons). Live animals on rookeries or haulout sites accounted for 88 per cent of all resights; only 9 per cent of all resights occurred in coastal areas frequented by people; 1.4 per cent restranded as a result of fisheries interactions. Animals were resighted alive up to 843 days post-release; dead restrandings averaged 120 days after release.

Most rehabilitated pinnipeds are not returning to centers or restranding dead and may be presumed to be returning to wild populations. Scant data are available concerning the potential for rehabilitated pinnipeds to interact with fisheries or utilize human related sources of food in the wild. Recommendations to improve scientific and management value of the tagging program include more thorough data recording and an increase in resighting effort.

INTRODUCTION

Each year large numbers of pinnipeds come ashore mainland California beaches to rest or recuperate from illness and injury (Seagars et al. 1986; Hansen 1983; Henderson and Hansen 1983). When live "stranded" animals come into contact with humans on the developed coast they typically are taken to one of the six rehabilitation centers in the California Marine Mammal Stranding Network (CMMSN) as authorized by the National Marine Fisheries Service (NMFS). At these centers, pinnipeds with a variety of maladies (Otten 1979; Smalley and Griffen 1979; Sweeney and Geraci 1979) are treated with increasing sophistication (Dierauf and Dougherty 1983; Dierauf et al. 1981). Surviving individuals not requiring long-term medical attention are released back into the wild. Rehabilitation centers are treating an increasing number of stranded pinnipeds, yet little has been written concerning the fate of these animals upon return to the wild (Webber and Allen 1986; Ridgway and Robison 1985; Harvey et al. 1983).

Ridgway and Prescott (1979) pondered the quandary of pinniped rehabilitation programs: should treated animals be released or retained? They noted that retained animals could be used to fulfill collection requests for public display facilities. Excess animals could be returned to the wild. However, animals released may be more likely to interact with fisheries, transmit disease contracted while in captivity, or lower genetic fitness as a result of human interference in natural selection. These authors proposed that a study be initiated to assess the fate of released animals.

In 1983, a program was initiated to ensure that all pinnipeds treated by rehabilitation centers in California are tagged with a uniquely numbered and colored plastic cattle ear tag prior to their return to the wild (Seagars 1983). The purpose of this report is to provide a preliminary assessment of the fate of released rehabilitated pinnipeds based on tag-resight information. This analysis considers the following questions: 1) Are rehabilitated pinnipeds surviving in the wild after release from treatment centers? 2) Are these animals returning to areas and exhibiting behavior typical for "wild" stocks? 3) Are released individuals becoming "problem" animals by interacting frequently with fisheries or chronically restranding?

METHODS

Plastic cattle ear tags were provided to the six marine mammal rehabilitation centers operating in California in May 1983 (Appendix). Tags were sequentially numbered with a unique four digit number and coded so that the center releasing the animal could be identified easily. The orange tag - black numeral

arrangement was chosen because of its visibility and so as not to conflict with the color - number sequences of tags attached to wild pinnipeds. Two tag types were used: the Temple cattle ear tag and the Dalton Rotoriese.[1] The Temple tag was initially selected because it was the only tag available in orange. The orange Dalton tag became available in January 1985, and was substituted for the Temple tag because of complaints about the difficult process used to secure the Temple tag.

Candidates for release were single tagged at some date prior to their return to the sea. California sea lions (Zalophus californianus) and northern fur seals (Callorhinus ursinus) were tagged in the front flippers. Northern elephant seals (Mirounga angustirostris) and harbor seals (Phoca vitulina) were tagged in the webbing of the rear flippers. Centers were requested to tag males on the left and females on the right. The exact timing of tagging was left to the discretion of the center.

When an animal was released, the center notified the NMFS by submitting an update of the stranding report form used by the CMMSN to report all stranding events. Deficiencies in vital data (e.g. date, location, tag nos., species) were rectified by contacting center representatives and requesting the missing information. Latitude and longitude were plotted based on a location description provided in reports or by contacting the information source. The coordinates of release for some centers were assigned based on an assumed "generic" release point identified by the center (e.g. "all our releases were made 12 mi. southwest of Point Loma").

During the early period of this study, several centers also released pinnipeds either without tags or with non-orange tags. Therefore, the animals considered here do not represent the total number of treated pinnipeds returned to wild populations during the sample period. In order to provide a concise analysis of the program based on a discrete time period, this analysis was limited to those orange tagged animals released between May 1, 1983 through December 31, 1985. All subsequent sightings (termed a "resight") of this group through the end of 1986 were included. Thus, the amount of time any specific animal was "at large" and available for resight was a function of its release date within the study period. The range of this period was from 365 - 1,336 days.

Resights of tagged released animals were obtained through several approaches: (1) Animals that subsequently re-stranded were reported to the NMFS through the standard CMMSN report form. (2) Some investigators conducting pinniped field studies contribute reports of tag resights to a database maintained at the NMFS,

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1 The use of trade names does not constitute an endorsement by the National Marine Fisheries Service.

Southwest Fisheries Center (Wexler 1985). All records of orange tags from the SWFC database were obtained for this analysis. (3) All known research groups conducting pinniped field studies on the west coast of the U.S. were requested by letter to send reports of orange tag resights to the author.

All release and resight records were complied into an RBase5000 (see fn. 1) database for analysis. This database (named "SIGHT") contains an individual record for each tag or resight event; each animal is identified by its unique tag number or "keytag". Each record may have data in 36 attributes pertaining to time and location of the event or to biological data (e.g. sex, species, weight). An example showing the field of attributes for several records is provided in the Appendix. The following results were obtained by querying the database for one or more attributes using the arithmetic commands of the software.

RESULTS

Between May 1983 and December 31, 1985, six California rehabilitation centers treated and released 398 stranded pinnipeds (266 Z. californianus, 97 M. angustirostris, 33 P. vitulina, and 2 C. ursinus) with orange plastic cattle ear tags provided by the NMFS (Table 1). In those cases where the age class of the animal was indicated (60 per cent of the reports; Table 2, Figure 1), roughly 90 per cent of the released animals were of young age classes (juvenile, yearlings, or pups). For harbor seals and elephant seals, roughly equal numbers of males and females were treated and released. More male than female California sea lions were released (Table 3).

California sea lions

Most sea lions were released in two general regions on the California coast (Table 4); roughly equivalent numbers were released in the Gulf of the Farallons south to Año Nuevo (Figure 2) or scattered throughout the Southern California Bight (SCB) to the Mexican border (Figure 3). Sixty-nine sea lions were released at offshore islands near rookeries or haulout sites (e.g. Southeast Farallon, Santa Cruz, or Anacapa Islands, contra Ridgway and Robinson 1985) where conspecifics were present.

Of the 266 California sea lions released, 204 (76.6 per cent) were not resighted through the end of 1986, 45 (16.9 per cent) were resighted alive once or more (some up to 14 times) on offshore rookeries or haulout sites, 11 (4.1 per cent) were post-release mortalities, six (2.2 per cent) restranded alive on the mainland coast and were retreated and re-released (5 not resighted, 1 resighted twice) (Tables 5 & 6). Nine of the 11

dead animals were found on mainland beaches, the other 2 were found on Southeast Farallon. Only 2 sea lions were found to have died as a result of fisheries interactions.

Of the 51 sea lions resighted alive, 18 were not seen beyond 60 days after release, 20 were last seen between 2-6 mo. post-release, 7 were last observed between 6-12 mo. post-release, and 7 were resighted 1 yr. or more after release (Table 7, Figure 4). The mean "time-at-large" (number of days elapsed between date of release and the date of last resight) for sea lions last seen alive was 139.7 days (range 0-575; S.D.= 141.7).

Northern elephant seals

Northern elephant seals were released in the same two general regions as California sea lions; however almost twice as many were released in the Gulf of the Farallons area as were released in the SCB (Table 4). Most elephant seals (61) were released in or near rookeries or haulouts (e.g. Chimney Rocks, Point Reyes, or Southeast Farallon Island) where conspecifics were present.

Of the 97 northern elephant seals released, 75 (77.3 per cent) were not resighted through the end of 1986, 19 (19.6 per cent) were resighted alive once or more (some up to 15 times) on rookeries or haulout sites, 2 (2.1 per cent) animals "restranded" dead, and one "restranded" alive on the mainland coast, was retreated and re-released (it was not resighted) (Table 5). The three animals that restranded were found on mainland beaches (Table 6).

Of the 19 elephant seals resighted alive, 12 were not seen beyond 60 days after release, 5 were last seen between 2-6 mo. post-release, 2 were last observed between 6-12 mo. post-release, and 1 was resighted 843 days after release (Table 7, Figure 4). The mean "time-at-large" for northern elephant seals last seen alive was 111.4 days (S.D.= 193.1).

Harbor seals

Thirty-three harbor seals were released at various locations along the California coast (Table 4). Three seals were observed alive (one resighted 6 times) on haulout sites with other seals; one was seen 360 days after release. One released pup was found dead on a mainland beach 25 days after release. One seal was captured alive in a fisheries interaction 290 days after release and subsequently was re-released.

Northern fur seals

Only two northern fur seals were treated and released during the study period; neither was resighted.

Treatment time

The time in treatment varied between centers and within species at various centers (Table 8). While some centers appeared to hold certain species longer for treatment than others, there was no correlation between treatment time and "time-at-large" for California sea lions (r=0.096) or for northern elephant seals (r=-0.274). However, two factors make it difficult to interpret these data: (1) the decision to release an animal is subjective and may include reasons other than its health, and (2) "survivorship" is biased by a regional skew to the resight effort (see below).

Tag characteristics

There were 182 resights of 70 animals tagged with Temple tags and 49 resights of 19 animals with Rotoriese tags. Animals were single tagged only and the two tag types were out for unequal periods (Rotoriese tagged animals had less chance to be resighted). Therefore, the rate of tag loss for the tag types used (292 Temples, 106 Rotoriese) cannot be estimated.

DISCUSSION

A disproportionate number of the animals resighted were of those released in the northern portion of the study area (70 northern area releasees resighted as compared to 19 SCB area releasees resighted). The differences in resight rate on northern and southern rookeries likely are due to geographic variation in resight effort, topographic configuration of haulout sites, and animal behavior. Observational effort on the Farallon Islands and to some extent at Año Nuevo is high. Field researchers observe animals daily at these locations during the fall and winter periods or almost daily at other times throughout the year. These periods correspond with the northern elephant seal reproductive season and the seasonal migration north for California sea lions. The sites are small and tagged pinnipeds are fairly easily spotted from blinds and towers above the colonies. In contrast, most sea lion and elephant seal rookeries on the southern California Channel Islands are visited infrequently for short periods primarily during the breeding seasons of these species. Island colonies are large and are

located on long broad beaches. Behavioral observations and tag resights are made on foot and usually at distances which make reading tag numbers quite difficult. Futhermore, female and young California sea lions released in the SCB may be moving south into Mexican waters where no resight data are available, while northern elephant seals tended to remain in the (northern) area of their release where resight effort was high.
Only a few harbor seals were resighted. This is not unexpected because: (1) there are only a few investigators working with this species in California; (2) harbor seal colonies are generally observed from greater distances than other pinniped species and are distributed over a wide coastal area; and (3) harbor seal behavior makes it difficult to read tags: seals often hold tagged rear flippers closed, covering the tags, and they may "flush" (run into the water) when approached closely.

A significant number of resighted California sea lions and northern elephant seals were remaining on or moving to areas traditionally used by others of their species rather than returning to areas used by people (X^2=89.2, P<0.001 for sea lions; X^2=28.7, P<0.001 for elephant seals, Table 9, Figures 5 & 6). Thirty-one of the 89 pinnipeds resighted were first observed at the point of release; 27 of these were only resighted at the release location. Some animals moved considerable distances to rookeries or haulout sites far from their release point (Figures 7 & 8); these movements suggest successful return to a free ranging existence.

I found no evidence that a critical readjustment period follows release. If this was occurring, mortalities would have been more frequent during some period immediately following release. There was no significant difference in mean "time-at-large" (days from release to date of last resight) between dead restrandings and animals last seen alive (Two Sample Test, P<0.01 for both sea lions and elephant seals; Table 10).

The rates of tag loss cannot be calculated from the data considered here. However, I suspect that loss rates for the tags used in this study are likely to be as low or lower than rates reported by others (between 5-20 per cent: Huber and Johnston 1987; Bowen and Sergeant 1983; Abegglen et al. 1958 in Eberhardt et al. 1979) because: (1) the tags used in this program are very similar to types used on the same or similar species for which loss rates have been estimated and (2) most centers held animals for several weeks to months after tagging and replaced lost or malfunctioning tags prior to release (J. Roletto, B. Andrews pers. comm.). In order to estimate directly the loss rate of the one tag type still in use (Rotoreise), a double tagging program for all releases has been initiated at one center.

The proportion of resights in marine mammal mark-recapture studies has been reported to vary widely (10-90 per cent) and

appears to be related closely to tagging and observational locale as well as to the degree of movement or site-fidelity of the population under scrutiny. Resight rates for two species considered in this study (23 per cent - sea lions, 22 per cent - elephant seals) compare favorably with rates reported by tagging studies of marine mammal species which are wide ranging and are not highly site specific (e.g. about 17.4 per cent for harp seals: Bowen and Sergeant 1983; 12 per cent for polar bears: DeMaster et al. 1980). I consider the return rates reported here to be very good because: 1) animals were released independently over a great geographic area and broad seasonal periods which were not necessarily timed to the appropriate seasonal distribution of the species; 2) resight effort was opportunistic; and 3) tag loss has not been factored into return rates.

CONCLUSIONS AND RECOMMENDATIONS

It is possible to address Ridgway and Prescott's (1979) quandary by making some preliminary conclusions concerning the fate of rehabilitated pinnipeds released from California centers. Only a fraction (3 per cent) of the reported resights were attributed to interactions with human activities. Therefore, it is likely that rehabilitation center programs are not producing animals contributing to a measurable increase in marine mammal - fishery interactions.

Only a very small percent of released rehabilitated pinnipeds were observed in public areas or reported to restrand; most resights were of animals on offshore or mainland rookeries or haulout sites. Thus these animals may be: (1) returning to wild stocks and displaying typical behavior; (2) restranding without tags due to extremely high tag loss rates; or (3) moving to areas where they are not resighted.

Of the three hypotheses, I believe the first seems to be the most plausible because of the following circumstantial evidence: (1) The resight rate was comparable to, or higher than, results from mark-recapture studies of other wide-ranging marine mammals where the population is large. (2) While most animals released were of younger age classes where annual survival is perceived to be low (e.g. $\leq$ 42 per cent for first year northern elephant seals: Huber and Johnston 1987; 59 per cent for first year California sea lions: Aurioles and Sinsel 1988), the mean "time-at-large" calculated for California sea lions and northern elephant seals indicates that a large number of these animals are surviving for periods of sufficient duration to infer successful reintegration. However, a convincing argument for any one of these hypotheses is not possible at the present time because: (1) resight data rarely included field notes on behavior; (2) rates of tag loss are unknown; (3) resight effort is unevenly distributed.

When addressing the quandary concerning possible effects of released animals to wild stocks, it should be noted that the number of released animals relative to their total population size is minuscule. Of the four species considered here, those returned to the wild in any one year were generally less than 0.1 per cent of their total population (Table 11). Thus it seems clear that the principle benefit of releasing animals from rehabilitation centers is directed at the individual: this includes both the pinniped in treatment and the personnel working in the center. Rehabilitation center programs serve a second, perhaps more noteworthy, purpose by serving as a source of animals for public display facilities and research. Rehabilitated individuals have fulfilled the demand for California pinnipeds for these purposes; no collections have been made from the wild for public display since 1980.

Progress toward rectifying deficiencies in our understanding of the fate of released rehabilitated pinnipeds can be made by implementing the following actions:

1. Continue the tagging program to increase the sample size and duration of time back in the wild. This will result in surviving younger age class animals moving into breeding aggregations where they will become the subject of study by a number of biologists likely to report resights.

2. Continue the double tagging initiated by one center in order to assess rates of tag loss and to relate these rates to overall recapture probability.

3. Revise the tag-resight report form to make it more thorough and simple to complete in the field. In particular, focus on inclusion of more detailed behavioral observations. Distribute to all field research groups and rehabilitation centers.

4. Contact field research groups to encourage increased resight effort in the Southern California Bight and Mexico. Solicit additional unreported resight reports which may exist in field notes.

5. Reassess the results of this preliminary study when additional data become available; calculate annual survival rates for released rehabilitated pinnipeds.

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Table 1. Numbers of pinnipeds released with orange tags by rehabilitation centers, May 1983 - December 1985.

Species	Rehabilitation Center of Release						
	A[1]	B	C	D	E	F	Total
Z. californianus	13	25	85	13	6	124	260
M. angustirostris	12	9	13	1	1	61	97
P. vitulina	1	5	3	3		21	33
C. ursinus						2	2
Total	26	39	101	17	7	208	398

1/ Center A did not begin using orange tags until June 1984.

Table 2. Age class of pinnipeds released from California marine mammal rehabilitation centers with orange tags, May 1983 - December 1985.

	Adult		Immature		Yearling		Pups		Age Class	Age Class	
Species	N	%*	N	%	N	%	N	%	Identified	Unknown	Totals
Z. californianus	5	3.0	67	40.1	75	44.9	20	12.0	167	99	266
M. angustirostris	1	1.3	12	15.6	19	24.7	45	58.4	77	20	97
P. vitulina			2	6.9	3	10.3	24	82.8	29	4	33
C. ursinus							2	100.0	2		2
Pooled Total	6	2.2	81	29.5	97	35.3	91	33.1	275	123	398

* Per cent of total of age class identified by species group.

Table 3. Sex of pinnipeds released with orange tags from CMMSN rehabilitation centers May 1983 - December 1985.

	Males		Females		Unknown		
Species	N	%	N	%	N	%	Total
Z. californianus	157	59.0	90	33.8	19	7.2	266
M. angustirostris	46	47.4	45	46.4	6	6.2	97
P. vitulina	15	45.5	17	51.5	1	3.0	33
C. ursinus			2	100.0			2

Table 4. Location of releases.

Area[1]	Zalophus	Mirounga	Phoca	Callorhinus
Anacapa Island*#	4			
Santa Cruz Island*	9			
Farallon Islands*#@	56	4	1	1
San Clemente to Newport Beach	23	8	3	
Newport Beach to Oxnard (South)	85	14	5	
Oxnard to Pt. Arguello		1	1	
Morro Bay to Monterey	6	1	2	
Monterey to Golden Gate (South)#	10	2	14	
Golden Gate to Tomales Bay#@	60	55	6	1
At sea (San Diego to Pt. Conception)	13	12	1	

1/ Areas are unequal in size and were chosen based on an arbitrary system resident in Southwest Fisheries Center tag database (see Wexler 1985). Symbols indicate region included rookery area or haulout site for the species indicated (* = Zc; # = Ma; @ = Pv). Areas without symbols were categorized for this analysis as a region not typically used by pinnipeds for resting or breeding.

Table 5. Nature and frequency of resight events for orange tagged pinnipeds.

Event Category	Zalophus	Mirounga	Phoca	Callorhinus	Total	%
# Released	266	97	33	2	398	
Not resighted	204	75	28	2	309	77.6
Resighted alive once or more	45	19	3	-	67	16.8
Post release mortalities	11	2	1	-	14	3.5
Restranding/Re-release	5	1	1	-	7	1.8
Restranding/Re-release/ resighted	1	-	-	-	1	0.3

Table 6. Distribution of resights. Includes both dead and alive animals and multiple resights of individual animals. No Callorhinus were resighted.

Area[1]	Zalophus	Mirounga	Phoca
San Nicolas Island*#@		1	
San Clemente to Newport Beach	1		
Newport Beach to Oxnard (South)	11	3	
Oxnard to Pt. Arguello@	3		
Año Nuevo Island*#		6	
Monterey to Golden Gate (South)#	7	2	1
Farallon Islands*#@	134	39	3
Golden Gate to Tomales Bay@#	2	1	8
North of Tomales Bay @	1	1	
At sea (San Diego to Pt. Conception)			1

1/ Areas are unequal in size and were chosen based on an arbitrary system resident in Southwest Fisheries Center tag database (see Wexler 1985). Symbols indicate region included rookery area or haulout site for the species indicated (* = Zc; # = Ma; @ = Pv). Areas without symbols were categorized for this analysis as a region not typically used by pinnipeds for resting or breeding.

Table 7. Frequency distribution of the date of last resight. These data used to calculate the mean "time at large" for animals last seen alive, an approximation of minimum survival time.

Resight Period In Days	Z. californianus			M. angustirostris			P. vitulina		
	Dead	Restrand	Live Sighting	Dead	Restrand	Live Sighting	Dead	Restrand	Live Sighting
0-60	5	4	14	1	2	10	1		1
61-120	1		10	1		3			
121-180	2	1	9			2			
181-240	1		5			2			1
241-300		1						1	
301-360									1
361-420	2		5						
421-480									
481-540			1						
541-600			1						
601-660									
661-720									
721-780									
781-840									
841-900						1			

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Table 8. Comparison of the number of days animals were held for treatment by various centers prior to their release back to the wild ($\bar{X}$ = mean, (N) = number of animals, R = range).

Center* / Species	A	C	D	F
	Time in the rehabilitation process			
	$\bar{X}$ (N) R	$\bar{X}$ (N) R	$\bar{X}$ (N) R	$\bar{X}$ (N) R
Z. californianus	217 (13) 39-464	142 (89) 19-1335	22 (14) 2-115	100 (125) 34-196
M. angustirostris	116 (12) 43-252	67 (13) 11-150	1 (1) 1	142 (61) 1-357
P. vitulina	55 (1) 55	52 (3) 6-137	167 (3) 5-252	139 (21) 2-196

* Center B records were incomplete for this analysis. Center E sample size was too small to consider.

Table 9. Location and status of resighted animals.

Species \ Area	Haulouts & Rookeries		Coastal Populated		Fisheries Interactions	
	Live	Dead	Live	Dead	Live	Dead
Z. californianus	45	2	6	7		2
M. angustirostris	19		1	2		
P. vitulina	3			1	1	
Pooled	67	2	7	10	1	2

Table 10. Comparison of "time-at-large" and distance traveled for released rehabilitated pinnipeds dependent on condition last reported.

Animals last seen:	ALIVE				DEAD			
	Time-at-large[1]		Distance[2]		Time-at-large		Distance	
	$\bar{X}$	(S.D.)	$\bar{X}$	(S.D.)	$\bar{X}$	(S.D.)	$\bar{X}$	(S.D.)
Z. californianus	139.7[3]	(141.7)	19.2[4]	(53.4)	141.5[3]	(133.5)	27.3	(34.9)
M. angustirostris	111.4[5]	(193.1)	60.9	(92.8)	66.0[5]	(41.1)	94.6	(122.9)
P. vitulina	228.3	(137.1)	43.2	(28.0)	25[6]		36.8	

1/ In number of days between release date and date of last resight (1338 maximum days possible).

2/ Distance is straight line distance in miles from release location and point of last resight.

3/ No significant difference ($t_{calc} = 0.017$, $t_{\alpha .05} = 0.985$, Do not reject H_o).

4/ $\bar{X}$ distance of those that moved 41.7 (73.2).

5/ No significant difference ($t_{calc} = 0.479$, $t_{\alpha .05} = 0.637$, Do not reject H_o).

6/ One animal.

Table 11. Comparison of the number of reported strandings (both alive and dead) in a particular year with the number eventually released with an orange tag from that years stranders.[1]

Species	Approximate 1987 N. Amer. Population Size	1983 Reported[1] Strandings	1983 Releases[2]	1983 %[3]	1984 Reported Strandings	1984 Releases	1984 %	1985 Reported Strandings	1985 Releases	1985 %
Z. californianus[4]	177,000	1,750	150	8.5	624	91	14.6	260	20	7.6
M. angustirostris	100,000	241	35	14.5	99	32	32.3	94	30	31.9
P. vitulina	42,000	232	11	4.7	103	6	5.8	64	16	25.0
C. ursinus	800,000	19	1	5.2	2	1	50.0	6	-	0.0

1/ Data for reported strandings in 1983 and 1984 from Seagars et al. 1986; 1985 data from Seagars and Jozwiak (1988, submitted).

2/ Number of pinnipeds released which originally stranded this year.

3/ Value is per cent released of those stranded in respective year.

4/ Five released Zalophus were of pre-1983 strandings.

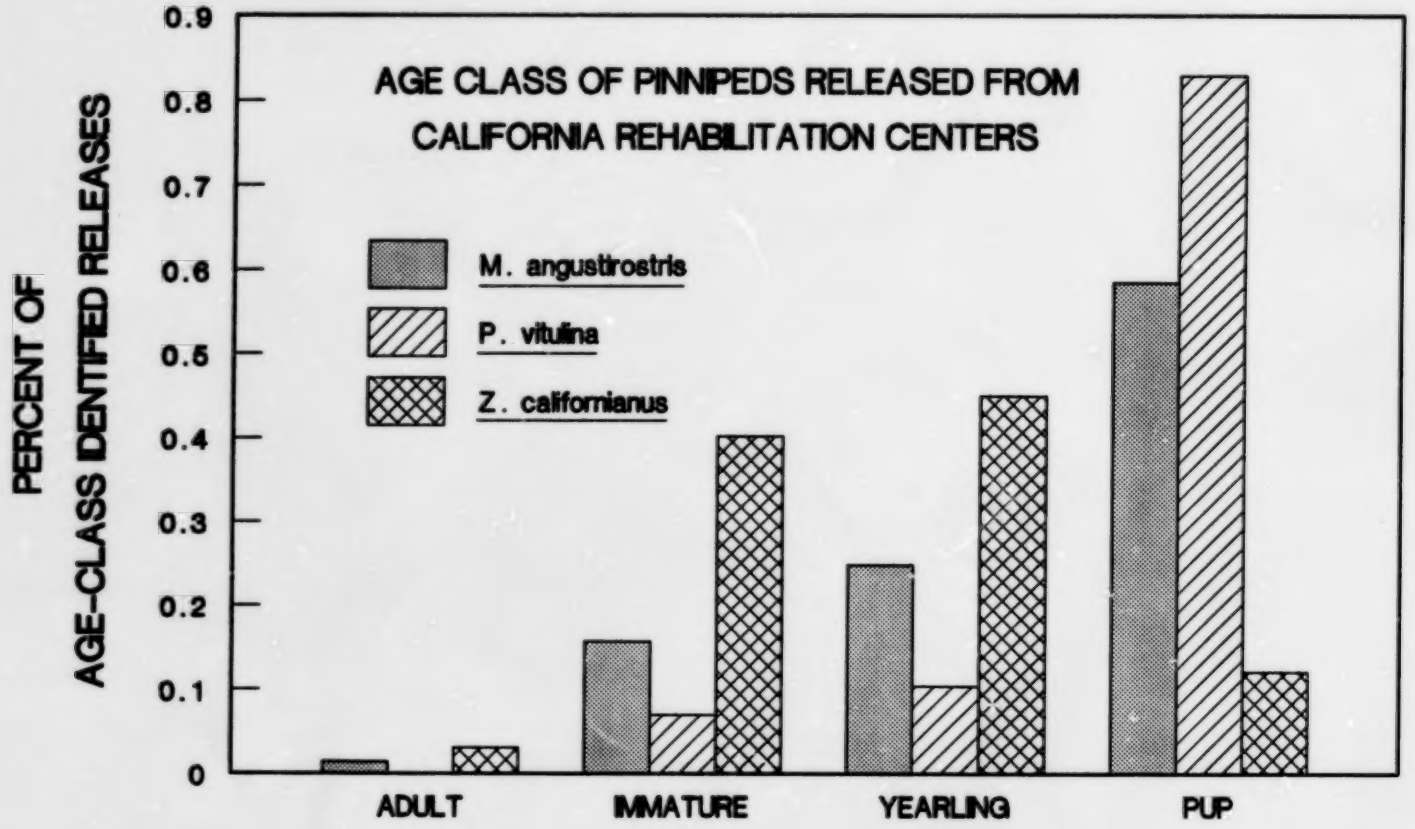

Figure 1. Age class of pinnipeds treated and released from California rehabilitation centers, May 1983 - December, 1985.

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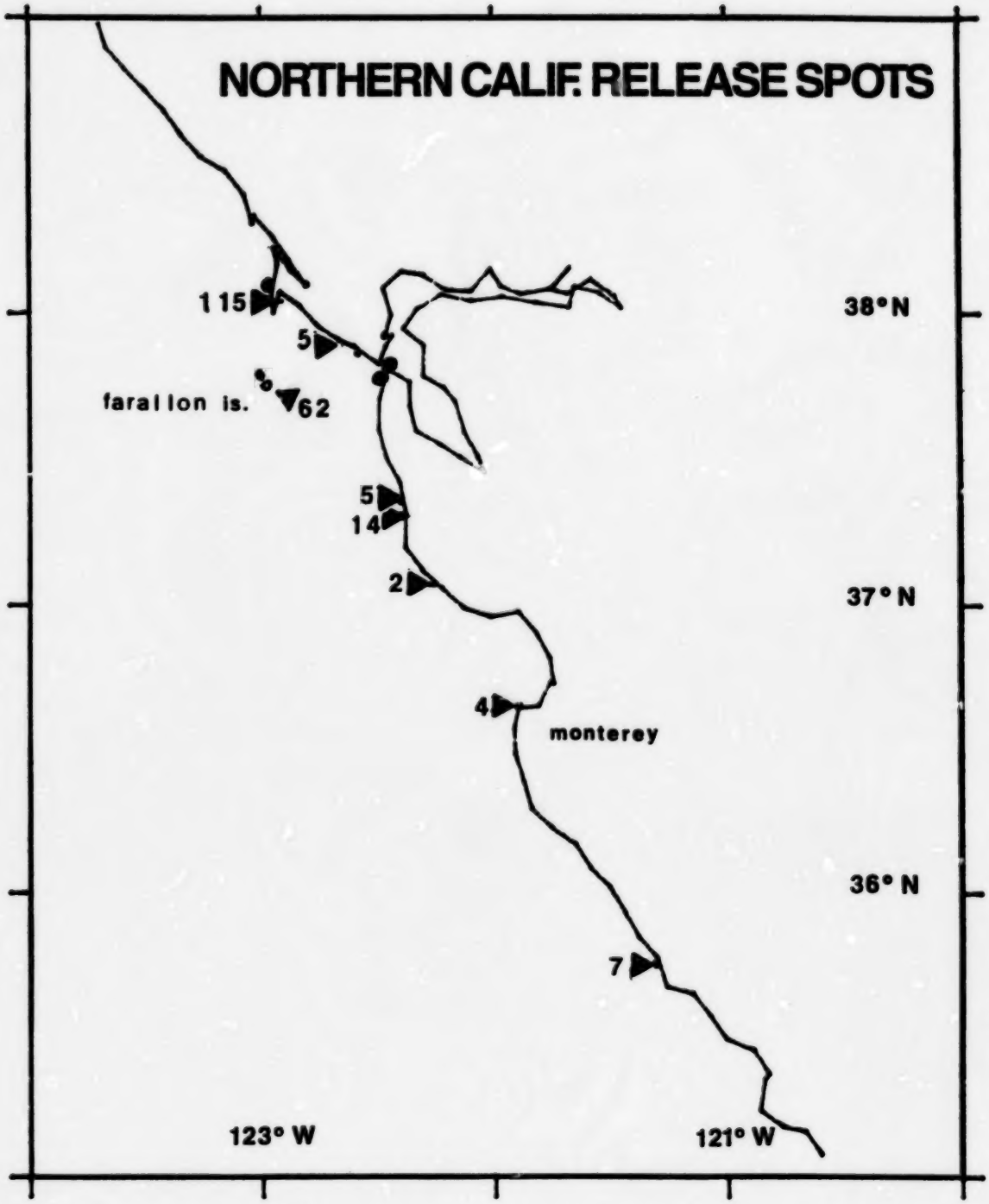

Figure 2. Release location of treated pinnipeds in northern California. Dots (●) indicate single animal releases, triangles indicate locations of multiple releases.

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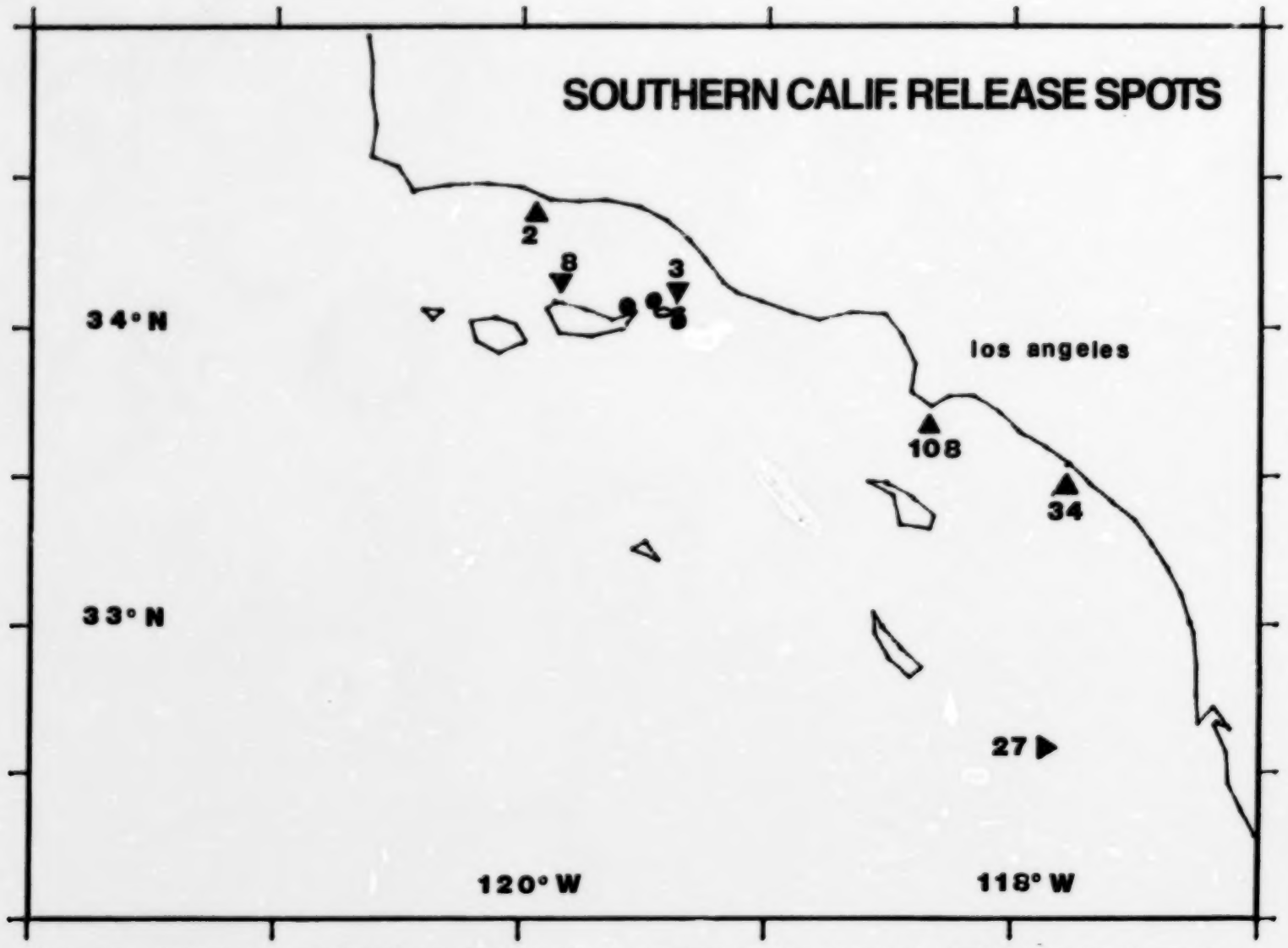

Figure 3. Release locations of treated pinnipeds in southern California. Symbols as in Figure 2.

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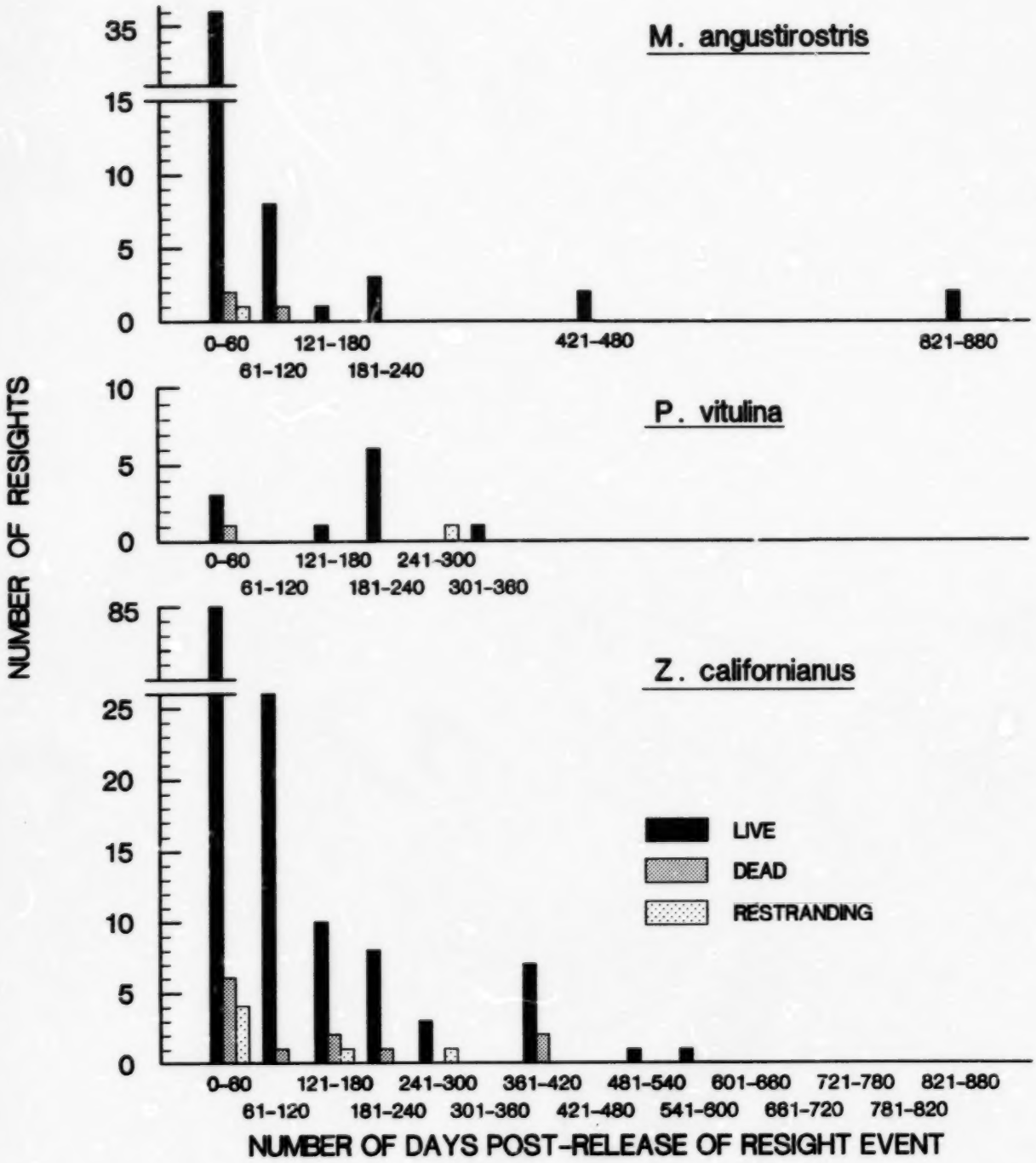

Figure 4. The number of resights as a function of the time at large. Includes multiple resights of individual animals.

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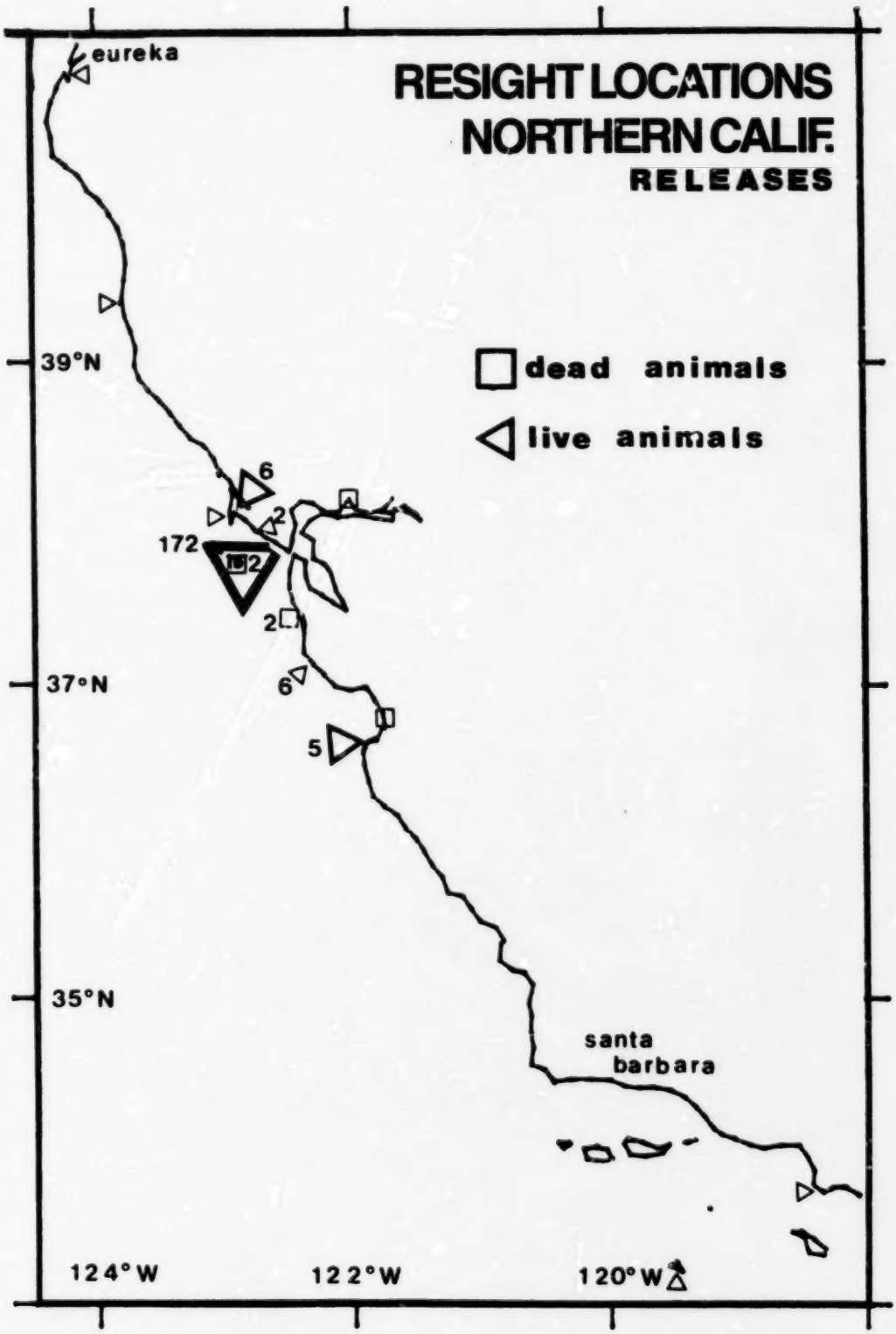

Figure 5. Resight locations of northern California released rehabilitated pinnipeds.

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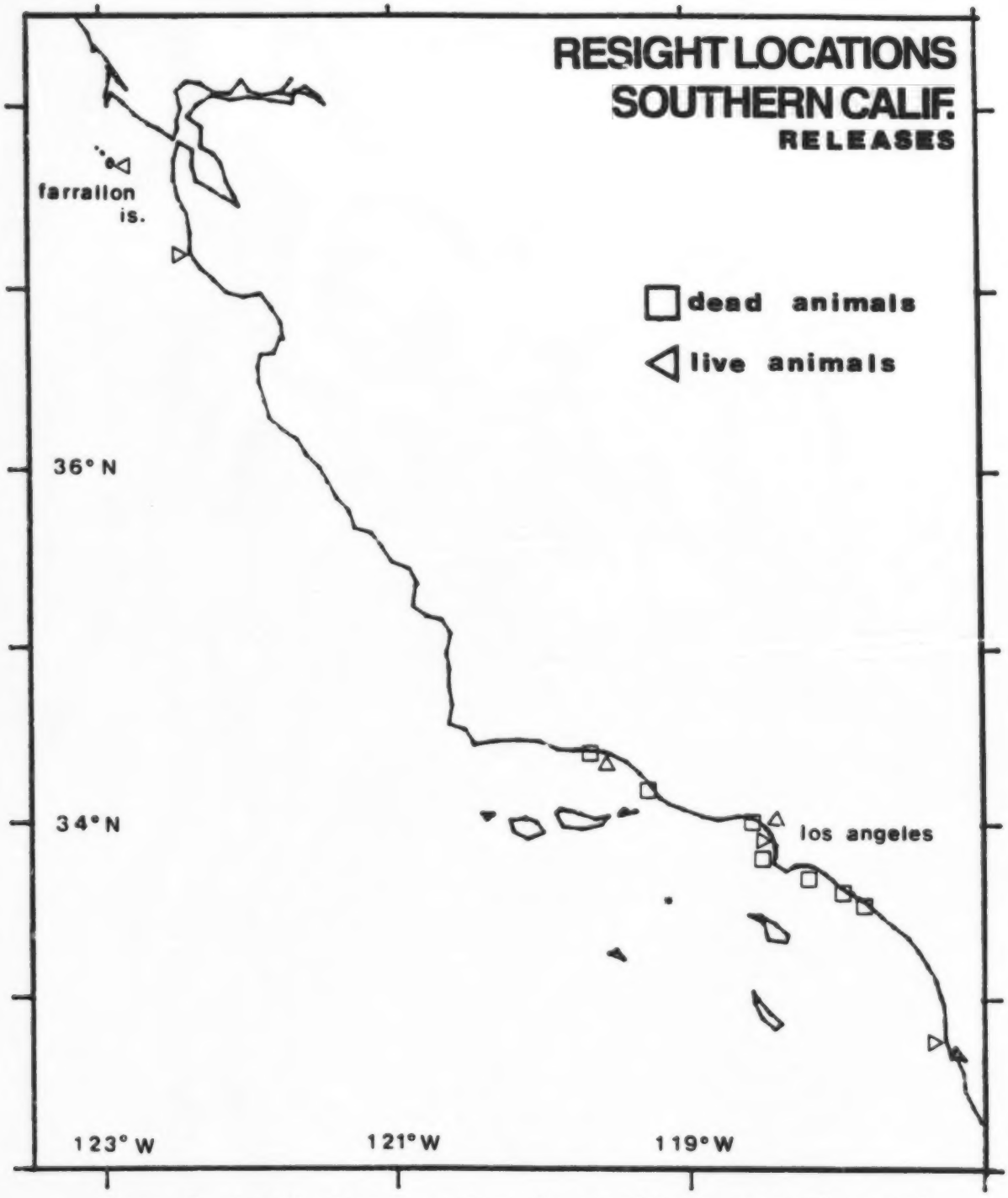

Figure 6. Resight locations of southern California released treated pinnipeds.

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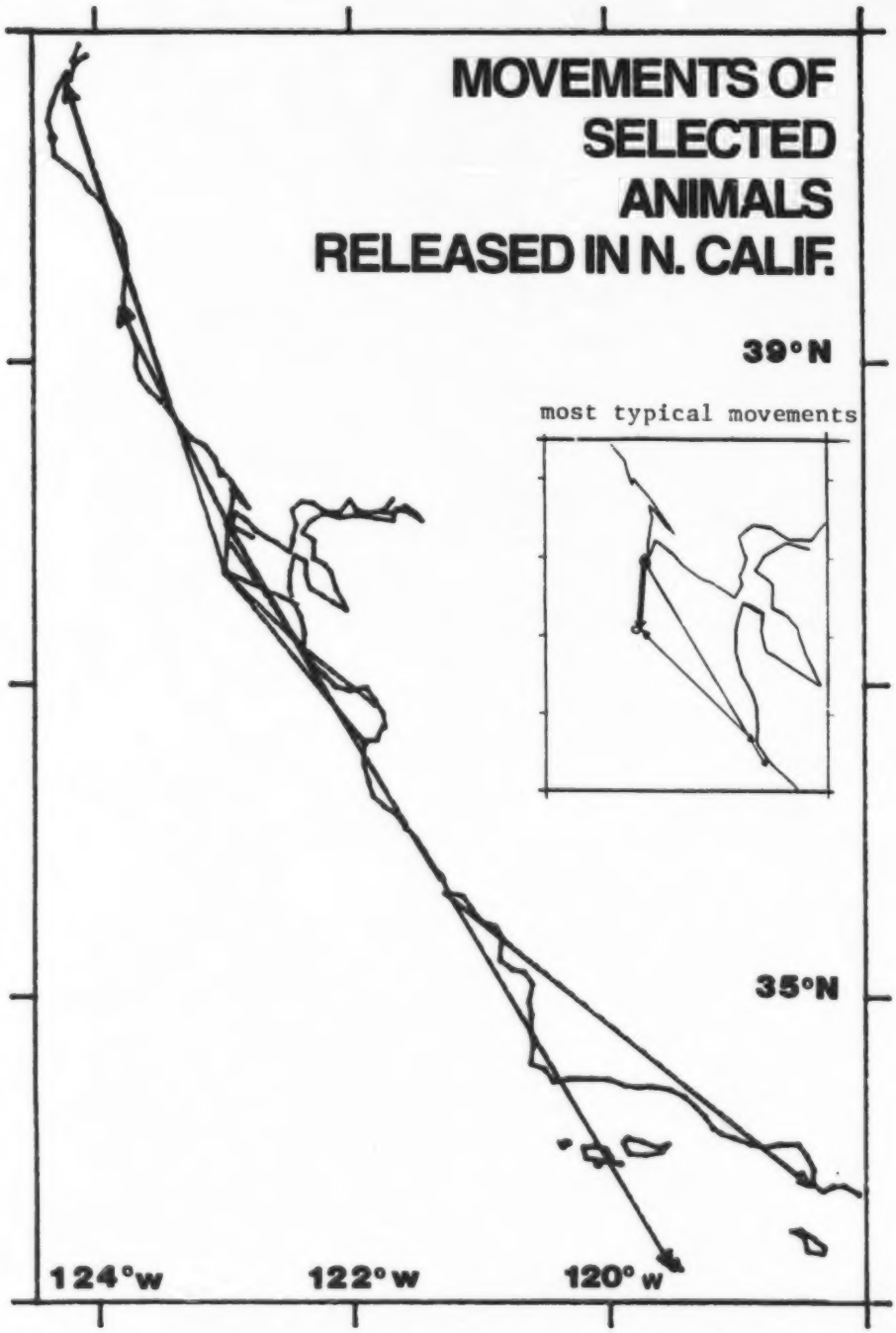

Figure 7. Movements of selected animals released in northern California. Inset indicates frequently reported movements between mainland release points at Chimney Rocks and Bean Hollow Cove tc the Farallon Islands and from releases at the Farallones to and from the Ano Nuevo area.

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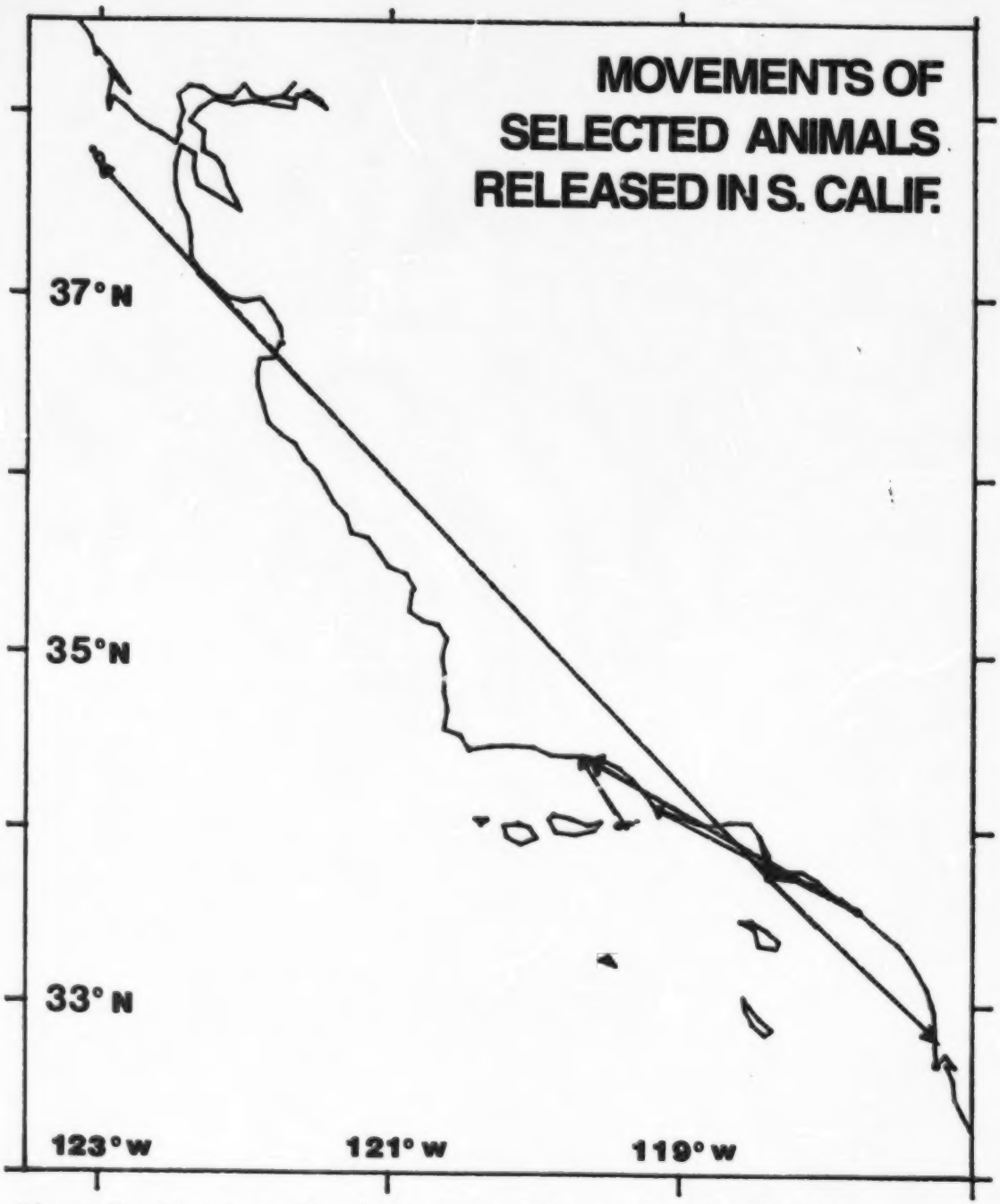

Figure 8. Movements of animals released in southern California.

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APPENDIX: Example of database structure for tag-resight data.

THIS IS A PRINTOUT OF ALL DATA FROM THE FILE "SIGHT" DATE OF PRINTING: 9/17/87

TAG	DOE	TOD	SWC	BLW	LAT	LONG	NAME	HWA	OBS	S	T	TPR	TN1	TC1	TT1	TCO	TPR	TN2	TC2	TT2	TCO	AC	AS	LE	LU	GI	GU	WGT	WG	S.D	COM	transid	cedate	flat
1[illegible]DTP	84/[illegible]/01	-:-	19	-0-	324[illegible]0	1173[illegible]0	Z		1	P		M	I	M	-0-	-0-	-0-	-0-	Y	1001	D	TP	N	G	-0	-0	-0	-0	-0	-0	-0	B301004	RELEASE	SWC	ZC	B3130		87/01/15	83/01/07	419
10[illegible]DTP	84/03/01	-0-	19	-0-	324040	1173000	Z		1	P		F	T	Y	1692	D	TP	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B305272	RELEASE	SWC	ZC	B33009		87/01/15	83/05/31	275
1[illegible]DTP	84 03 01	-0	19	-0-	324000	11.3600	Z		-:-	Y		F	T	Y	1003	D	TP	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B211006	RELEASE	SWC	ZC	B2111B		87/01/15	82/11/23	464
10[illegible]4DTP	84/02/01	-0-	19	-0-	324000	1173000	Z		1	P		F	T	Y	1004	D	TP	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B305271	RELEASE	SWC	ZC	B33140		87/01/15	83/05/03	303
1[illegible]5DTP	84/10/16	-0-	19	-0-	324000	1173000	M	-0-	P		M	I	Y	1005	D	TP	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B405018	RELEASE	SWC	MA	B4259		87/01/15	84/05/03	144
1[illegible]6DTP	84 10/16	-0-	19	-0-	324000	1173000	M		1	P		M	T	Y	8061	R	RE	G	Y	1006	D	TP	N	G	-0	-0	-0	-0	-0	-0	-0	B405019	RELEASE	SWC	MA	B4059	previously tagged w/ B/BIRRE	87/06/29	84/05/29	141
1[illegible]7DTP	84 10/16	-0-	19	0-	324000	1173000	M	-0-	Y		F	T	N	-0-	-0-	-0-	-0-	Y	1007	D	TP	N	G	-0	-0	-0	-0	-0	-0	-0	B402003	RELEASE	SWC	MA	B4148		87/01/15	84/02/07	252
1[illegible]8DTP	84/1[illegible] 1E	-0-	19	-0-	324000	1173000	M	-0-	Y		M	T	Y	1008	D	TP	N	N	-0-	-:-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B409096	RELEASE	SWC	MA	B4499		87/01/15	84/09/03	43
1[illegible]9DTP	84 11/01	-0-	19	-0-	324000	1173000	Z	-0-	J		F	T	N	-0-	-0-	-0-	-0-	Y	1009	D	TP	N	G	-0	-0	-0	-0	-0	-0	-0	B405002	RELEASE	SWC	ZC	B4413		87/01/15	84/05/05	190
1[illegible]0AR	85/[illegible]/17	-0-	19	-0-	324000	1173000	Z	-0-	S		F	T	N	-0-	-0-	-0-	-0-	Y	1301	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B402017	RELEASE	SWC	ZC	B4210		87/01/15	84/02/21	292
13[illegible]1AR	85 [illegible]1/17	-0-	19	-0-	324000	1173000	Z	-0-	W		M	T	Y	1302	D	RR	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B409009	RELEASE	SWC	ZC	B4249		87/01/15	84/09/08	204
13[illegible]2AR	85/01/17	-0-	19	-0-	324000	1173000	Z	-0-	P		M	T	Y	1303	D	RR	N	N					G	-0	-0	-0	-0	-0	-0	-0	B402007	RELEASE	SWC	ZC	B4188	HELD AT SCRIPPS FOR APP. 1 MON.	87/01/15	84/02/25	327
1304AR	85 0[illegible]/29	-0-	19	-0-	324000	1173000	M	-0-	Y		F	T	N				-0-	Y	1304	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B503016	RELEASE	SWC	MA	B5119		87/01/15	85/03/31	81
13[illegible]5AR	85 04/05	-0-	19	-0-	324000	1173000	M	-0-	Y		M	T	Y	1305	D	RR	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B502005	RELEASE	SWC	MA	B5028		87/01/15	85/02/10	54
1306AR	85/[illegible]/05	-0-	19	-0-	324000	1173000	M	-0-	Y		F	T	N	-0-	-0-	-0-	-0-	Y	1306	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B412010	RELEASE	SWC	MA	B4580		87/01/15	84/12/24	102
13[illegible]2AR	85/[illegible] 20	-0-	19	-0-	324000	1173000	M	-0-	P		F	T	N					Y	1312	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B504016	RELEASE	SWC	MA	B5116		87/01/15	85/04/16	65
13[illegible]3AR	85 [illegible] 29	-0-	19	-0-	324000	1173000	M	-0-	Y		F	T	N					Y	1313	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B503015	RELEASE	SWC	PA	B511D		87/01/15	85/03/29	83
1[illegible]4AR	85 [illegible] 21	-0-	19	-0-	324000	1173000	Z	2	V		F	T	N	-0-	-0-	-0-	-0-	Y	1314	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B505017	RELEASE	SWC	ZC	B5250		87/08/14	85/05/22	92
13[illegible]5AR	85/[illegible] 26	-0-	19	-0-	324000	1173000	Z	-0-	P		M	T	Y	131[illegible]	D	RR	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B504019	RELEASE	SWC	ZC	B5190		87/01/15	85/04/26	61
1[illegible]7AR	85 [illegible] 20	-0-	19	-0-	324000	1173000	M	-0-	P		M	T	Y	1317	D	RR	N	N	-:-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B503010	RELEASE	SWC	MA	B5040		87/01/15	85 03/16	96

TAG	DOE	TOD	SWC	BLW	LAT	LONG	NAME	HWA	OBS	S	T	TPR	TN1	TC1	TT1	TCO	TPR	TN2	TC2	TT2	TCO	AC	AS	LE	LU	GI	GU	WGT	WG	SID	COM	transid	cedate	flat
1[illegible]6AR	85/[illegible]/26	-0-	19	-0-	324000	1173000	Z	-0-	A		F	T	N					Y	1316	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B505015	RELEASE	SWC	ZC	B5276		87/01/15	85/05/18	39
1[illegible]9AR	85/08/22	-0-	19	-0-	324000	1173000	F	-0-	Y		M	T	Y	1319	D	RR	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B506003	RELEASE	SWC	PV	B5370		87/06/26	85 06/28	55
1320AR	85/05/28	-0-	19	-0-	324000	1173000	M	-0-	P		F	T	N	-0-	-0-	-0-	-0-	Y	1320	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B512016	RELEASE	SWC	MA	B5450		87/06/29	85/12/14	104
1321AR	85/09/24	-0-	19	-0-	324000	1173000	Z	-0-	P		F	T	N	-0-	-0-	-0-	-0-	Y	1321	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B5[illegible]022	RELEASE	SWC	ZC	B5410	PCHD W INJURIES ASSOC. W/ FISH INTERACT	87/05/26	85/08/08	47
1322AR	85 [illegible] 24	-0-	19	-0-	324000	1173000	Z	-0-	P		F	T	N	-0-	-0-	-0-	-0-	Y	1322	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B508023	RELEASE	SWC	ZC	B5469	PCHD W/ BROKEN RF FLIPPER	87/06/26	85/08/27	49
1323AR	86 [illegible]5/09	-0-	19	-0-	324000	1173000	M	-0-	Y		F	T	N	-0-	-0-	-0-	-0-	Y	1323	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B603056	RELEASE	SWC	MA	B6158		87/09/08	86/03/14	56
1324AR	86/09/[illegible]	-0-	19	-0-	324000	1173000	M	-0-	P		F	T	M	-0-	-0-	-0-	-0-	Y	1324	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B603055	RELEASE	SWC	MA	B6079		87/06/29	86/03/22	167
1325AR	86/07/10	-0-	19	-0-	324000	1173000	M	-0-	P		M	T	Y	1325	D	RR	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B603054	RELEASE	SWC	MA	B6088		87/06/29	86/03/22	167
1326AR	86 [illegible]2/10	-0-	19	-0-	324000	1173000	M	1	P		M	T	Y	1326	D	RR	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B603057	RELEASE	SWC	MA	B6098		87/09/08	86/03/26	2
1327AR	86/07/10	-0-	19	-0-	324000	1173000	M	1	P		F	T	N	-:-	-:-	-0-	-:-	Y	1327	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B604052	RELEASE	SWC	MA	B6108		87/06/29	86/04/04	97
1328AR	86/09/05	-0-	19	-0-	324000	1173000	M	1	P		M	T	Y	1328	D	RR	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B604051	RELEASE	SWC	MA	B6218		87/08/29	86/04/26	132
1329AR	86/[illegible]/10	-0-	19	-0-	324000	1173000	M	-:-	P		F	T	Y	-0-	-0-	-0-	-:-	Y	1329	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B604050	RELEASE	SWC	MA	B6218		87/06/29	85/04/28	73
133[illegible]AR	85/[illegible]/10	-:-	19	0-	324000	1173000	M	-0-	Y		L	T	M	-0-	-0-	-0-	-0-	Y	1330	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B604049	RELEASE	SWC	MA	B6218		87/06/29	86/04/30	71
1332AR	86/07/10	-0-	19	-0-	324000	1173000	Z	-0-	A		F	T	N	-0-	-0-	-0-	-0-	Y	1332	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B605002	RELEASE	SWC	ZC	B6278		87/06/29	86/05/02	69
1333AR	86/[illegible]/1	-0-	19	0-	324000	1173000	Z	-0-	A		F	T	N	-0-	-0-	-0-	-0-	Y	1333	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B608004	RELEASE	SWC	ZC	B6478		87/06/29	86/08/31	31
1334AR	86/[illegible]/01	-:-	19	0-	324000	1173000	Z	-0-	A		F	T	N	-0-	-0-	-0-	-0-	Y	1334	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B608005	RELEASE	SWC	ZC	B6418		87/06/29	86/08/29	33
1[illegible]5AR	87 [illegible]/23	-:-	19	-0-	324000	1173000	M	0	Y		F	T	N	-0-	-0-	-0	-0-	Y	1336	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B612002	RELEASE	SWC	MA	B6468		87/06/29	86/12/09	52
1 41[illegible]6	85 11	-0-	19	-0-	324000	1173000	M	1	P		M	T	Y	1341	D	RR	N	N	-0-	-0-	-0-	-0-	G	-0	-0	-0	-0	-0	-0	-0	B5[illegible]4014	RELEASE	SWC	MA	B5146		87/08/14	85/04/12	209
1[illegible]7AR	87 [illegible]/23	-0-	19	-0-	324000	1173000	Z	-:-	P		F	T	N	-0-	-0-	-0-	-0-	Y	1342	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B702011	RELEASE	SWC	ZC	B7138		87/05/29	87/12/22	68
1[illegible]4AR	8[illegible]/05 21	-0-	19	-0-	324000	1173000	Z	-:-	P		F	T	N	-0-	-0-	-0-	-0-	Y	1344	D	RR	N	G	-0	-0	-0	-0	-0	-0	-0	B7[illegible]00[illegible]	RELEASE	SWC	ZC	B7138		87/05/29	87/07/29	51
[illegible]	[illegible]	TOD	SWC	BLW	LAT	LONG	NAME	HWA	OBS	S	T	TPR	TN1	TC1	TT1	TCO	TPR	TN2	TC2	TT2	TCO	AC	AS	LE	LU	GI	GU	WGT	WG	SID	COM	transid	cedate	flat

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